Reprinted From October 12, 1964

Aviation Week
& Space Technology

Real-Time Reconnaissance Tests Planned

AVIONICS

Real-Time Reconnaissance Tests Planned

By Barry Miller

Los Angeles—Flight tests of a tactical airborne multi-sensor system capable of securing several types of reconnaissance data, including television and side-looking radar mapping information, then relaying them over a wideband data link to a ground terminal for real-time evaluation by military field commanders will get under way late this month under Project See Fast (AW&ST Aug. 3, p. 21).

See Fast will be part of an extended series of airborne exercises, known as Gold Fire (AW&ST Sept. 21, p. 77), through which Air Force will be testing its capability to provide close air support to Army ground troops. See Fast will test both the feasibility of the multi-sensor system and the value of transmitting real-time reconnaissance data to the field commander.

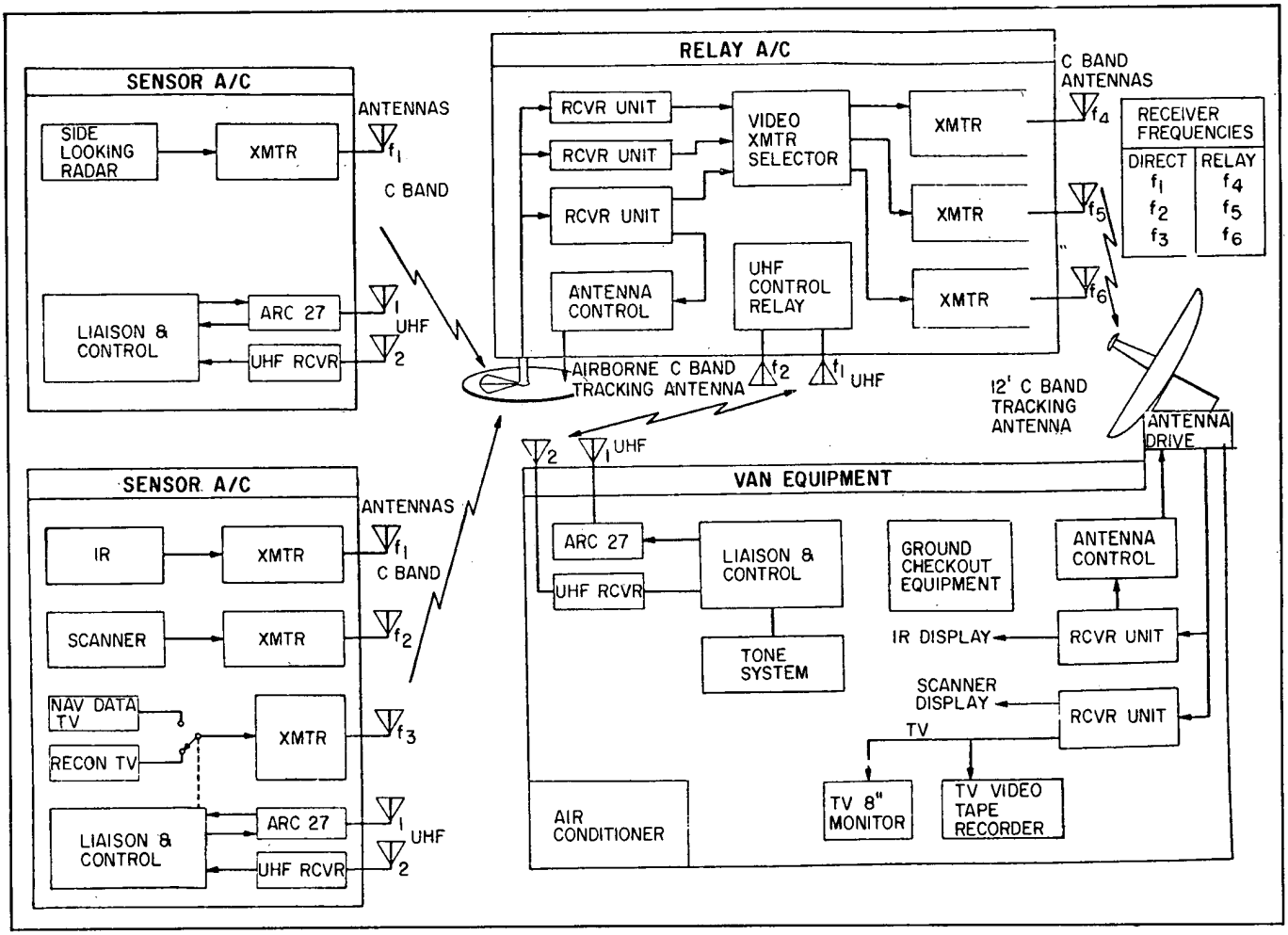
The Air Force is becoming increasingly aware of the need for cutting the time lag between securing reconnaissance information of various types and evaluating it. Project See Fast will attempt to see whether a big step toward this goal may be taken by returning data obtained by several sensors from the reconnaissance aircraft over several channels of the wideband data link to field commanders.

Another approach to the same problem is to process partially in the air, possibly to format or organize the data, before aircraft return or for immediate transmission to the ground. A further refinement of this would be to process the data in real time entirely in the air, permit a co-pilot to evaluate it and enable a reconnoitering aircraft to perform a strike mission before returning to its base. Ideas like this are attracting much attention.

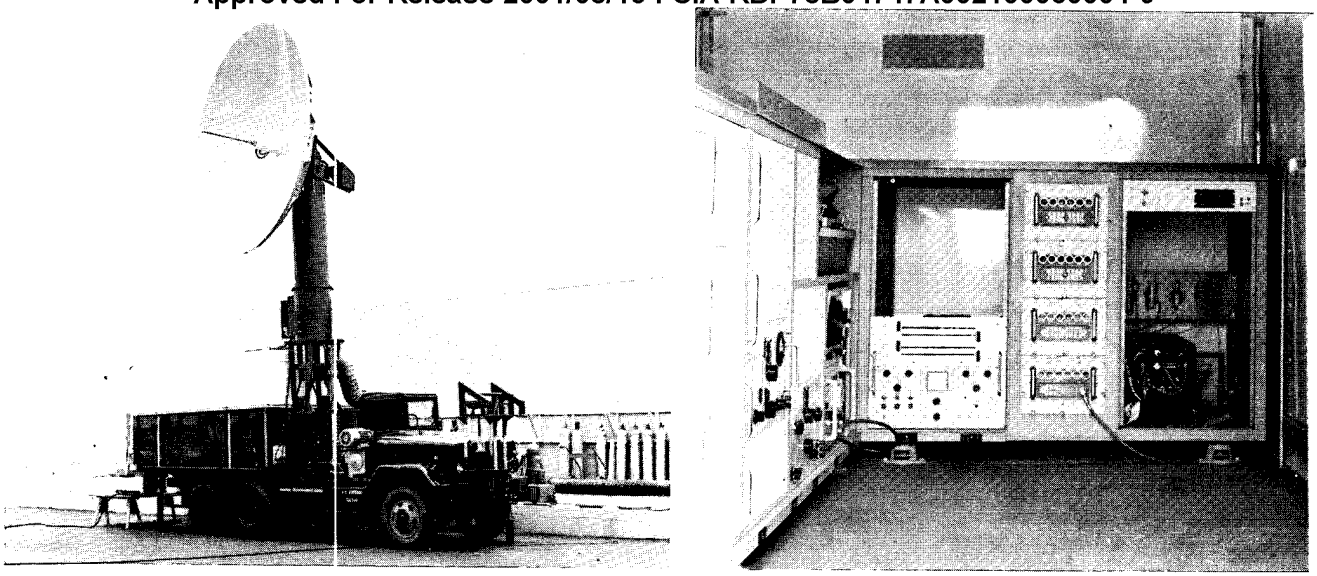
In this connection, Air Force's Aeronautical Systems Div. is expected to seek Systems Command approval for a continuation of Project 665A (AW&ST July 20, p. 21), an evaluation of getting real-time, multi-sensor outputs through on-board data processing. While a rudimentary form of this concept has undergone flight testing, full scale tests apparently are awaiting resolution of Defense Dept. and Air Force re-evaluation of the entire reconnaissance picture.

If it continues, the 665A effort is expected to lead to development of a reconnaissance package for the RF-111A, the reconnaissance version of the General Dynamics F-111, should that aircraft come to fruition. This package probably would be a melding of sensors on the McDonnell RF-4C and new developments from the 665A project.

Early flight tests of the 665A reconnaissance subsystem, carried out with a Boeing JKC-135 (AW&ST Mar. 23, p. 51), demonstrated feasibility of integrating multi-sensor capability and were to



FUNCTIONAL BLOCK DIAGRAM of wide-band data link system developed for Air Force's See Fast project indicates elements in two RB-66 sensor aircraft and relay aircraft as well as ground terminal. See Fast concept permits information secured by indicated reconnaissance sensors to be returned to ground station via relay aircraft or directly to the ground in real time. Data link is a C-band system.



GROUND STATION VAN (left) of wide-band data link system which Cubic Corp. built for USAF's Project See Fast, an effort to gather television, photographic, radar and infrared reconnaissance data from airborne sensors and return them in real time to military field commanders. The 12-ft. dish folds back to permit van to be airlifted. Interior of ground station van (right) contains receiving equipment for three channels of reconnaissance data, along with tape recorder, test gear and miscellaneous equipment.

supply an indication of Air Force ability to use the information.

The See Fast project will employ a trio of modified Douglas RB-66 aircraft, two of which will carry avionic sensors with the third functioning as a relay aircraft to extend the range of the system. The aircraft will be operated out of Eglin AFB by TAC's Tactical Airborne Weapons Center. Douglas Aircraft is prime contractor to Aeronautical Systems Div. for See Fast.

The sensor aircraft will secure reconnaissance information over combat areas and relay it to the third, which will transmit the data over a data link to the ground terminal. As an alternative to the ground terminal, Air Force is having Ling-Temco-Vought outfit a Lockheed C-130 as an airborne command post.

A key element in the See Fast system is a wideband data link system, developed for this project by Cubic Corp., San Diego. The system is capable of sending video data derived from television cameras, photographic cameras, infrared detector and side-looking radar sensors. It operates in C band and has 4.5-mc. bandwidth at the 3-db. down points.

The video information is frequency modulated on three separate channels in the two sensor aircraft (see drawing, p. 73), which typically might be operating at low altitudes. Data is transmitted to the relay aircraft, flying at high altitudes, where signals are demodulated, filtered and remodulated onto three other carriers for transmission to the ground.

At the ground terminal, the signals are demodulated and the video is recorded and displayed. The system is designed to have an output signal/noise ratio of 40 db., which is sufficient for a maximum range of 80 naut. mi. between the sensor or reconnaissance aircraft and the relay aircraft and a relay aircraft to ground station distance of 650 naut. mi.

Voice communications can be linked into the RB-66 trio with the aid of the ARC 27 radio sets carried by the three aircraft. This will enable either of the sensor aircraft to talk to the ground terminal directly or through the relay aircraft. For this purpose, two audio tones can be generated and sent to the relay aircraft where they are detected and trigger a relay which turns on the ARC 27 transmitter.

One of the two sensor aircraft carries the side-looking radar, supplied by Texas Instruments, Inc., an associate contractor.

This provides a continuous map of the region to either side of the aircraft. Video and synchronizing information from the side looker is time multiplexed in a Cubic interfacing unit, while timing and synchronizing information signals are multiplexed with analog signals representing ground velocity information secured by the aircraft's Doppler navigator.

The composite signal modulates a single-channel data link transmitter operating at a nominal frequency of 4.5 gc. The modulated carrier is radiated through a collinear stub antenna, beneath the aircraft, directly to the ground terminal or, where greater range is desired, to the relay aircraft via an alternate antenna on top of the aircraft. Switching between the two is handled by a coaxial relay.

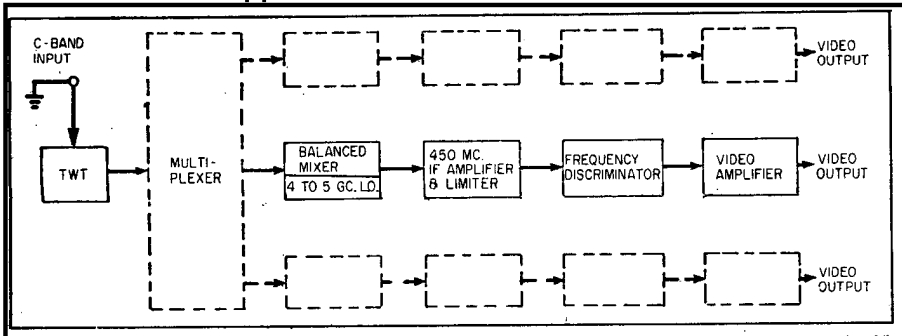
The other sensor aircraft carries four separate sensors whose outputs can be transmitted over three data link transmitters. One is modulated by the output of a photo scanner which scans the developed film of a picture obtained with a photographic camera. Philco Corp., another associate contractor, supplies the scanner. A separate film processor, to be used in the command post for reconstituting pictures, is to be supplied by Mark Systems, Inc., Santa Clara, Calif.

Also aboard the second sensor aircraft is an infrared camera and scanner, supplied by HRB Singer, and a pair of television cameras, provided by General Electric. One of the two cameras looks at the aircraft's instrument indicators, to secure for transmission various navigation data while the other, viewing the ground, functions as a reconnaissance TV camera. The outputs from either of these can be switched to modulate one

5-Sec. Photo Processor

A high-speed, rapid-access photographic processor which can process photographic reconnaissance films in 5 sec. will be incorporated in the airborne command and control center in Air Force's Project See Fast (see story). Made by Mark Systems, Inc., the processor yields a finished positive print to a photo interpreter and military commanders in the airborne command post, which is intended as a backup terminal in the See Fast project.

The processor uses Ansco Hyscan emulsion on a waterproof base paper and processes the film in 5 sec., makes it viewable in 7 sec. while simultaneously drying it and makes it available for handling in 25 sec. The processor stores the film in a slack box and will recall it on command. It can process as much as 250 ft. of film without requiring additional chemicals.



DATA LINK RECEIVER block diagram indicates present three-channel capability with 65-mc. bandwidth alloted to each channel. This can be increased to six channels of the same bandwidth. Channels are identical, but local oscillators are tuned to different frequencies.

data link transmitter. The three data link transmitters in the aircraft operate at nominal center frequencies of 4.45, 4.55 and 4.65 gc.

Data link outputs are all radiated through separate antennas either to the relay aircraft or the ground terminal via antennas at top and bottom, respectively, of the RB-66.

Television camera outputs are selected through the ARC 27 radio set in which an audio tone triggers a relay and switches the data link from the TV recon camera to the instrumentation TV camera.

Aboard the relay aircraft transmissions from either of the two sensor aircraft are received, demodulated, modulated on new carriers and retransmitted to the terminal.

The receiving antenna is a flush-mounted, steerable, phased array of six elements separated into two groups to provide a signal for an automatic tracking servo. Incoming signals are preamplified in a traveling wave tube and filtered to separate the three incoming channels. After being demodulated, the signal from each channel is remodulated on a different carrier. The transmitters are at nominal center frequencies of 4.75, 4.85 and 4.95 gc. Each one again has separate collinear antennas mounted below the aircraft. Power output is 20 w.

Cubic's ground data link equipment is installed in a modified van carrying a pedestal with a 12-ft.-dia. parabolic dish that folds down, permitting the entire van to be airlifted by a C-130 aircraft. The antenna provides about 42-db. gain and a conical-scan feed enables the narrow antenna beam to be locked automatically on the signals from the relay aircraft.

As in the relay aircraft, incoming signals are preamplified in a traveling wave tube and separated into separate channels located in two equipment drawers. The receivers are identical with those in the aircraft except for plug-in front ends which accommodate either relay aircraft signals or signals transmitted directly from the sensor aircraft. Receiver outputs are routed through a patch board to a display van, a TV monitor and a TV tape recorder, and to an IR display and photo scanner display in a second van.

The data-link transmitters are of solid-state design with the exception of a traveling wave tube and have output bandwidths of 70 mc. Similarly, the receivers are all solid-state except for TWT preamplifiers and local oscillator triodes. All channels are the same with the exception of the tuning of the local oscillator. Each receiver channel has 65-mc. bandwidth.

Maximum gain for the fixed antennas on the sensor aircraft is at ± 8 deg., depending on whether it is top or bottom mounted. For a sensor aircraft at 1,500-ft. elevation and ground station at zero elevation, the optimum altitude for the relay aircraft is 22,000 ft., according to Cubic calculations. Maximum gain for the bottom-mounted tracking antenna on the relay aircraft which tracks in azimuth only is at -12 deg.